Form ESA-B4. Summary Report for ESA-031-3
Public Report - Final

Company	Chrysler	**ESA Dates**	Mar 17-19, 2008
Plant	Indiana Transmission Plant 2	**ESA Type**	Compressed Air
Product	Automotive transmissions	**ESA Specialist**	B. Gopalakrishnan, Ph.D., P.E., C.E.M.

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: A three-day energy savings assessment (ESA) was performed at Chrysler Indiana Transmission Plant 2 in Kokomo, IN. The primary business of this company is the production of automotive transmissions. The company has three 1,250-hp centrifugal air compressors (Table 1) but only one (TA-compressor #3) is used to meet the plant air demand. The annual energy consumption by the compressors was estimated as 5,892,303 kWh (using profile data in AIRMaster+). The compressed air system was analyzed during this assessment and the potential annual savings in the electrical energy cost was estimated as 40% with respect to annual energy cost to run the compressor. The potential energy and cost savings are 2,354,631 kWh/yr (equivalent to 8,036 MMBtu/yr) and $117,749/yr respectively.

Objective of ESA: Improve compressed air system efficiency and reduce the operating cost for the company.

Focus of Assessment: Compressed air system.

Approach for ESA: Apply technical expertise and DOE BestPractices software tool AIRMaster+.

General Observations of Potential Opportunities:

Impact electrical cost is $0.02484/kWh and $14.51/kW

Energy Saving Assessment Results
Chrysler - Indiana Transmission Plant 2, Kokomo, IN 46904
Mar 17-19, 2008

This assessment consists of the application of AIRMaster+ developed by the US Department of Energy (USDOE), Industrial Technologies Program. The assessment consisted of training the plant personnel on the use of AIRMaster+ and the utilization of electrical and pressure data loggers for monitoring over an extended period. An ultrasonic air leak detector was used to identify compressed air leaks and a handheld pressure gage and power meter were used to obtain instantaneous pressure and power readings respectively. The historical current and flow readings were obtained through BayView control system present in the company and by observing the compressors' panels during the assessment. The 3-day assessment resulted in the following energy efficiency measures.

Recommendation 1: Improve End Use Efficiency

The major compressed air users in the plant are shot blast machines, gage tables, dust collectors, machine actuators, and several blow-off nozzles. The facility has over 100 nozzles in these areas that are used for 10-15 minutes each day. It was noted that these nozzles do not have the vortex design and hence use significant amount of compressed air. It is recommended to use vortex nozzles instead of regular nozzles wherever possible. Vortex nozzles reduce the compressed air demand to as low as 1/10th of the current compressed air demand. It is expected that the installation of vortex nozzles will not only reduce the requirement but will help the compressors to operate at almost constant level for longer time and hence increasing the life of the compressors. It was estimated that the compressed air requirement can be reduced by 300 cfm for the plant air system by the improving the end use efficiency. The energy, electrical demand, and cost savings from this recommendation are estimated as 306,005 kWh/yr (or 1,044 MMBtu/yr), 51 kW/month, and $16,409/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $10,000 with a simple payback of 0.6 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 2: Repair Air Leaks

A comprehensive study was performed to find compressed air leaks in the facility. An ultrasonic compressed air leak detector was used to identify the location of air leaks and quantify the energy and cost savings. The list of air leaks and the corresponding compressed air lost from the system are provided on Table 2. It was estimated that a total of 549 acfm was lost because of air leaks in the compressed air lines. It is recommended to initiate an ongoing compressed air maintenance program to locate and repair air leaks on a continuous basis. Based on assessment procedures, it is estimated that 75% of the leaks can be eliminated, amounting to a total of 412 acfm. The energy, electrical demand, and cost savings from this recommendation is estimated as 227,483 kWh/yr (or 776 MMBtu/yr), 69 kW/month, and $17,737/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $10,000 (including the purchase cost of an ultrasonic leak detector) with a simple payback of 0.6 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 3: Reduce System Air Pressure

Pressure loggers were installed in 6400 Heat Treat, Energy Center (near compressors), 6200 stator shaft B1, assembly J6, 6400 middle annum gear bay 9, and 6200 oil pump N2 areas. The compressed air pressure profile in the facility is shown in Figure 1. As seen from the pressure profiles, the compressed air pressure in the plant area fluctuates between 86 psig and 94 psig. A pressure drop of 7 psig was noticed between the compressor and the dryer as well. Based on the analysis of the pressure profile, it is recommended to install secondary storage tank(s) before major compressed air consumer(s) to reduce the pressure fluctuations which will help to reduce the overall system pressure settings. The benefits from this recommendation will be realized after replacing the regular nozzles with vortex nozzles, modifying the end users, maintaining the pressure dryer, and repairing the air leaks. Based on the expert's conservative estimates, it was estimated that the system pressure can be reduced by at least 3 psig. The energy, electrical demand, and cost savings from this recommendation is estimated as 246,741 kWh/yr (or 842 MMBtu/yr), 14 kW/month, and $8,625/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $2,000 with a simple payback of 0.2 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 4: Replace the Centrifugal Compressor with Two Screw Compressors and Use Automatic Sequencer

This recommendation is based on the analysis of the compressors' current consumption (Figure 2) and the amount of compressed air (acfm) generated on a typical production day (Figure 3 and Figure 4). Currently, the plant has three centrifugal compressors and only one of them works at any given time (at present #3). It was observed that the plant has two operating day types (production or weekdays and non-production or weekends/holidays) and the centrifugal compressor was blowing off a lot of compressed air (Table 3). Based on the operating characteristics of the plant, it is recommended to install two 350-hp two-stage oil-free screw compressors and use an automatic sequencer with them (recommended cascading controls settings are given in Table 4). After the automatic sequencer is installed, it is expected that one of the screw compressors will be operating at full load and the other compressor will be operating at part load, coming on based on demand for air. This will result in higher system efficiency and will eliminate the need for blow-offs. To the best of our knowledge, once the leaks are fixed and end use efficiencies addressed, two compressors are sufficient for handling the plant air demand. The proposed hourly power savings from this recommendation are shown in Figure 5 and Figure 6. The energy, electrical demand, and cost savings from this recommendation is estimated as 1,397,633 kWh/yr (or 4,770 MMBtu/yr), 185 kW/month, and $66,903/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $100,000 (assuming that the company can procure used compressors or get them from the sister facilities) with a simple payback of 1.5 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 5: Use Synthetic Lubricant for the Compressor

Replace hydrocarbon lubricant in the air compressor with a synthetic type lubricant. Industrial data demonstrates that synthetic lubricants have improved characteristics resulting in lower equipment frictional energy losses. It is estimated that the current energy consumption by the air compressor is lowered by 3% after replacing the regular lubricant with the synthetic lubricants. The energy, electrical demand, and cost savings from this recommendation is estimated as 176,769 kWh/yr (or 603 MMBtu/yr), 21 kW/month, and $8,075/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $5,000 with a simple payback of 0.6 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Conclusion

The implementation of Recommendations 1 through 5 for the plant air system is likely to save approximately 350-hp of used compressor capacity for a production day operation.

Appendix: Table and Figures

Table 1: Compressor Inventory

Compressor Unit	HP	Type	System
IR-compressor #1	1,250	Centrifugal	Plant Air
IR-compressor #2	1,250	Centrifugal	Plant Air
TA-compressor #3	1,250	Centrifugal	Plant Air

Table 2: Location of Compressed Air Leaks with Corresponding Air Loss (as per Ultrasonic Leak Detector Measurements)

Location	No. of Leaks	Estimated acfm loss
Arbor automation	1	8.33
Eng abrasive	1	14.98
Fuji	2	29.96
Gage table	2	23.31
Heller	2	29.96
Henry filter	2	41.58
Liebherr	3	31.64
Magdeburg Lathe	1	14.98
Magel hone	3	44.94
Pfauter-gleason hob	1	14.98
Westech	2	41.58

Table 3: Operating History of Compressor #3

Status	hours
Total run time	3,576
Full load time	17.5
Modulating time	1,717
Minimum Flow time	117
Blowing off time	1,723
Unloaded time	10.5

Table 4: Proposed Cascading Pressures for New Screw Compressors

Compressor #	Full load hours
Lead	110.0
2	105.0

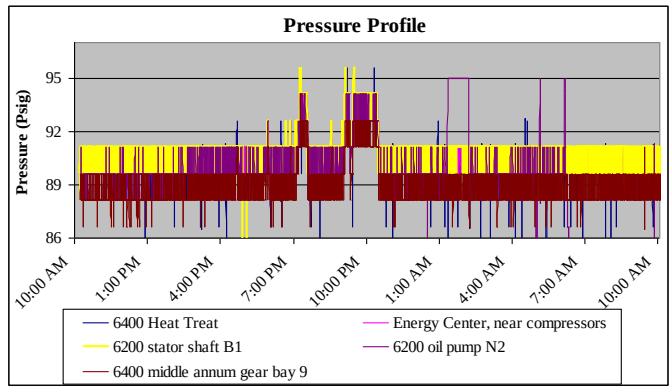

Figure 1: Pressure Profile for the Plant Air System

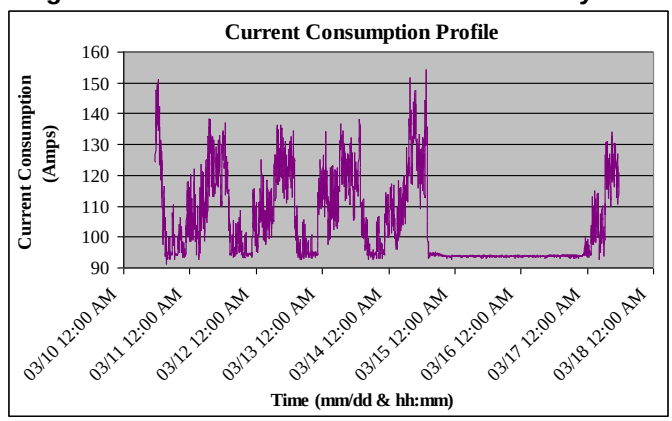

Figure 2: Profile of Current Consumption (Amps)

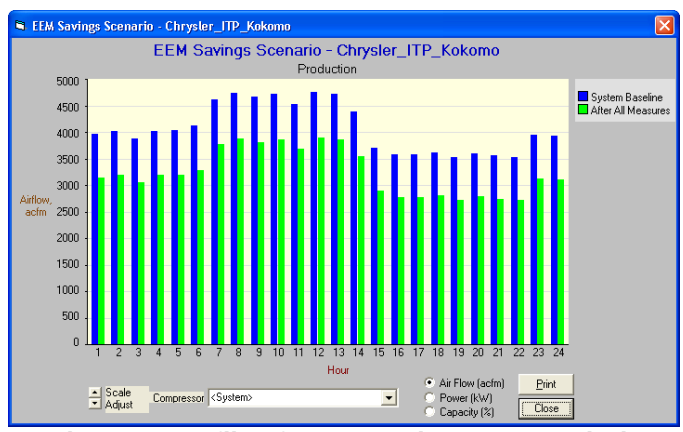

Figure 3: Profile of Generated Compressed Air Before and After (acfm) Implementation of Energy Savings Measures, Production Days

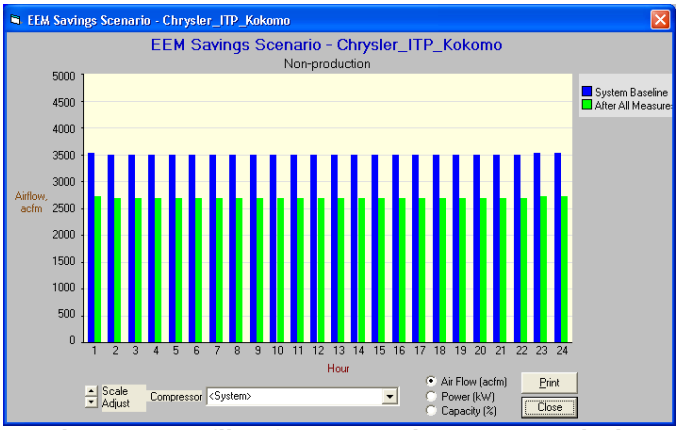

Figure 4: Profile of Generated Compressed Air Before and After (acfm) Implementation of Energy Savings Measures, Non-Production Days

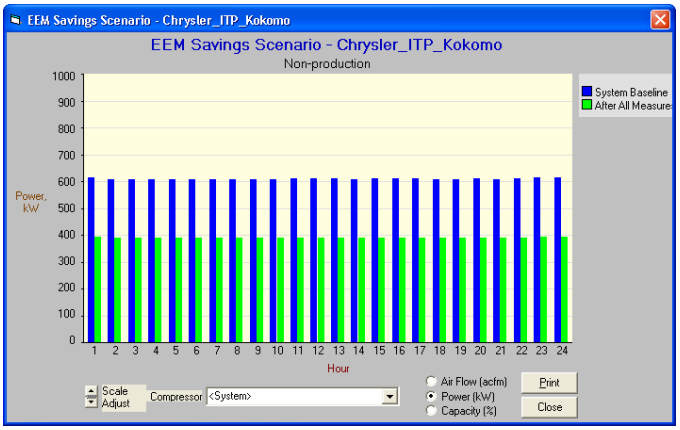

Figure 6: Hourly Profile for Power Savings during Non-Production Days

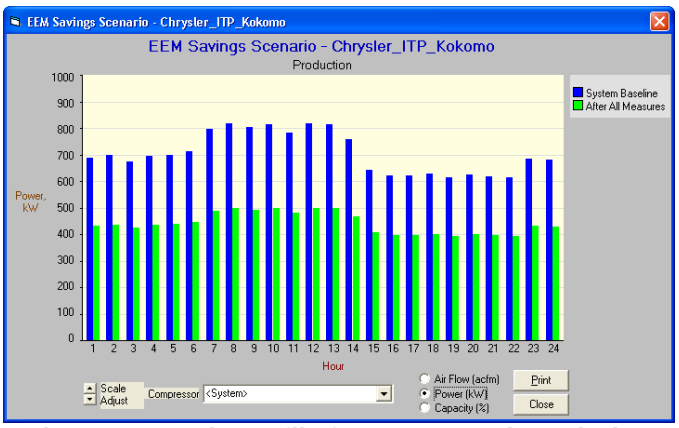

Figure 5: Hourly Profile for Power Savings during Regular Production Days

Management Support and Comments:

The management at the facility was very supportive and facilitated the productive completion of the assessment. The plant personnel were trained in the use of the AirMaster+ tool. The plant's contact person, Mr. Brian Klemmensen was in agreement with the preliminary findings outlined in this report. The individual comments are summarized in the "Consensus Evaluation" file.

Disclaimer

The purpose of the energy assessment conducted by Pro-Plus Engineering, PLLC on contract with the US Department of Energy is to identify and quantify savings opportunities using prevailing engineering principles. While the preliminary recommendations in this report have been reviewed for technical accuracy, they are based on observed conditions and information obtained during the assessment. Actual savings will depend on many factors, including measures implemented, operating procedures and variations in fuel prices and weather. This report is not intended to provide detailed engineering plans or designs. Pro-Plus Engineering, PLLC does not make any warranty with respect to the accuracy, usefulness or completeness of the savings estimates or the contents of this report. For this reason, your organization is encouraged to carefully evaluate each opportunity and attain further engineering analysis, if desired, to verify or refine any savings estimates.

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